

Amendments to the Claims

The following listing of claims replaces all prior versions, and listings, of claims in this application.

- 1 1. (Currently amended) A heat exchanger comprising: a body having a conducting portion
2 configured to be in contact with a heat source along a plane, wherein the conducting
3 portion is configured to conducts heat from the heat source to a heat exchanging layer
4 configured within the body, the body including at least one inlet port and at least one
5 outlet port, wherein the at least one inlet port channels fluid to fingers which branch out
6 in a plurality of directions from the at least one inlet port to the heat exchanging layer via
7 an intermediate layer with a plurality of conduits which extend therethrough, the heat
8 exchanging layer includes a porous microstructure disposed thereon and is configured to
9 distribute the fluid and to pass the distributed fluid therethrough, ~~further wherein the fluid~~
10 ~~is distributed such that at least one interface hot spot region in the heat source is~~
11 ~~selectively cooled.~~
- 1 2. (Canceled)
- 1 3. (Canceled)
- 1 4. (Canceled)
- 1 5. (Canceled)
- 1 6. (Canceled)
- 1 7. (Canceled)
- 1 8. (Original) The heat exchanger according to claim 1 wherein the at least one inlet port is
2 positioned substantially parallel with respect to the plane.

- 1 9. (Withdrawn) The heat exchanger according to claim 1 wherein the at least one inlet port
2 is positioned substantially perpendicular with respect to the plane.
- 1 10. (Original) The heat exchanger according to claim 1 wherein the at least one outlet port is
2 positioned substantially parallel with respect to the plane.
- 1 11. (Withdrawn) The heat exchanger according to claim 1 wherein the at least one outlet port
2 is positioned substantially perpendicular with respect to the plane.
- 1 12. (Previously presented) The heat exchanger according to claim 1 wherein the body further
2 comprises a plurality of fluid inlet grooves for channeling fluid from the at least one inlet
3 port to the heat exchanging layer.
- 1 13. (Previously presented) The heat exchanger according to claim 1 wherein the body further
2 comprises a plurality of fluid outlet grooves for channeling fluid from the heat
3 exchanging layer to the at least one outlet port.
- 1 14. (Original) The heat exchanger according to claim 1 wherein the fluid is in single phase
2 flow conditions.
- 1 15. (Withdrawn) The heat exchanger according to claim 1 wherein at least a portion of the
2 fluid is in two phase flow conditions.
- 1 16. (Original) The heat exchanger according to claim 1 wherein the conducting portion has a
2 thickness dimension within the range of and including 0.3 to 0.7 millimeters.
- 1 17. (Original) The heat exchanger according to claim 1 wherein an overhang dimension is
2 within the range of and including 0 to 15 millimeters.
- 1 18. (Withdrawn) The heat exchanger according to claim 1 wherein at least a portion of the
2 fluid undergoes a transition between single and two phase flow conditions in the heat
3 exchanger.

- 1 19. (Previously presented) The heat exchanger according to claim 1 wherein the heat
2 exchanging layer is made of a material having a thermal conductivity of at least 100
3 W/mK.
- 1 20. (Withdrawn) The heat exchanger according to claim 1 wherein the body further
2 comprises a plurality of pillars configured in a predetermined pattern along the heat
3 exchanging layer.
- 1 21. (Withdrawn) The heat exchanger according to claim 20 wherein at least one of the
2 plurality of pillars has an area dimension within the range of and including (10 micron)²
3 and (100 micron)².
- 1 22. (Withdrawn) The heat exchanger according to claim 20 wherein at least one of the
2 plurality of pillars has a height dimension within the range of and including 50 microns
3 and 2 millimeters.
- 1 23. (Withdrawn) The heat exchanger according to claim 20 wherein at least two of the
2 plurality of pillars are separate from each other by a spacing dimension within the range
3 of and including 10 to 150 microns.
- 1 24. (Withdrawn) The heat exchanger according to claim 20 wherein at least one of the
2 plurality of pillars includes at least varying dimension along a predetermined direction.
- 1 25. (Withdrawn) The heat exchanger according to claim 20 wherein an appropriate number of
2 pillars are disposed in a predetermined area along the interface layer.
- 1 26. (Withdrawn) The heat exchanger according to claim 1 wherein at least a portion of the
2 body has a roughened surface.
- 1 27. (Withdrawn) The heat exchanger according to claim 20 wherein the plurality of pillars
2 include a coating thereupon, wherein the coating has an appropriate thermal conductivity
3 of at least 10 W/m-K.

- 1 28. (Canceled)
- 1 29. (Previously presented) The heat exchanger according to claim 1 wherein the porous
2 microstructure has a porosity within the range of and including 50 to 80 percent.
- 1 30. (Previously presented) The heat exchanger according to claim 1 wherein the porous
2 microstructure has an average pore size within the range of and including 10 to 200
3 microns.
- 1 31. (Previously presented) The heat exchanger according to claim 1 wherein the porous
2 microstructure has a height dimension within the range of and including 0.25 to 2.00
3 millimeters.
- 1 32. (Previously presented) The heat exchanger according to claim 1 wherein the porous
2 microstructure includes at least one pore having a varying dimension along a
3 predetermined direction.
- 1 33. (Withdrawn) The heat exchanger according to claim 1 further comprising a plurality of
2 microchannels disposed in a predetermined configuration along the body.
- 1 34. (Canceled).
- 1 35. (Withdrawn) The heat exchanger according to claim 33 wherein at least one of the
2 plurality of microchannels has a height dimension within the range of and including 50
3 microns and 2 millimeters.
- 1 36. (Withdrawn) The heat exchanger according to claim 33 wherein at least two of the
2 plurality of microchannels are separate from each other by a spacing dimension within the
3 range of and including 10 to 150 microns.
- 1 37. (Withdrawn) The heat exchanger according to claim 33 wherein at least one of the
2 plurality of microchannels has a width dimension within the range of and including 10 to
3 100 microns.

- 1 38. (Currently amended) The heat exchanger according to claim 1 wherein the body is
2 coupled to the heat source.
- 1 39. (Withdrawn) The heat exchanger according to claim 1 wherein the body is integrally
2 formed to the heat source.
- 1 40. (Original) The heat exchanger according to claim 1 wherein the heat source is an
2 integrated circuit.
- 1 41. (Original) The heat exchanger according to claim 1 further comprising a thermoelectric
2 device positioned between the conducting portion and the heat source, wherein the
3 thermoelectric device is electrically coupled to a power source.
- 1 42. (Withdrawn) The heat exchanger according to claim 41 wherein the thermoelectric device
2 is integrally formed within the heat exchanger.
- 1 43. (Withdrawn) The heat exchanger according to claim 41 wherein the thermoelectric device
2 is integrally formed within the heat source.
- 1 44. (Original) The heat exchanger according to claim 41 wherein the thermoelectric device is
2 coupled to the heat exchanger and the heat source.
- 1 45. (Withdrawn) A heat exchanger configured to cool a heat source configured along a plane
2 comprising:
3 a. an interface layer having a thermal conductivity and configured to pass fluid from
4 a first side to a second side such that heat is passed from the interface layer to the
5 fluid passing therethrough; and
6 b. a manifold layer comprising:
7 i. a first layer in contact with the heat source and configured to pass fluid
8 therethrough to the interface layer, the first layer having an appropriate
9 thermal conductivity to pass heat from the heat source to the fluid passing

- 10 therethrough and to pass heat from the heat source to the first side of the
11 interface layer; and
12 ii. a second layer coupled to the first layer and in contact with the second side
13 of the interface layer.

1 46. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer further
2 comprises a recess area having a heat conducting region in contact with the interface
3 layer.

1 47. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer includes
2 the at least one inlet port.

1 48. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer includes
2 the at least one outlet port.

1 49. (Withdrawn) The heat exchanger according to claim 45 wherein the second layer includes
2 the at least one inlet port.

1 50. (Withdrawn) The heat exchanger according to claim 45 wherein the second layer includes
2 the at least one outlet port.

1 51. (Withdrawn) The heat exchanger according to claim 45 wherein the at least one inlet port
2 is positioned substantially parallel with respect to the plane.

1 52. (Withdrawn) The heat exchanger according to claim 45 wherein the at least one inlet port
2 is positioned substantially perpendicular with respect to the plane.

1 53. (Withdrawn) The heat exchanger according to claim 45 wherein the at least one outlet
2 port is positioned substantially parallel with respect to the plane.

1 54. (Withdrawn) The heat exchanger according to claim 45 wherein the at least one outlet
2 port is positioned substantially perpendicular with respect to the plane.

- 1 55. (Withdrawn) The heat exchanger according to claim 46 wherein the recess area includes
2 a plurality of fluid inlet grooves through in the heat conducting region, the fluid inlet
3 grooves for channeling fluid from at least one inlet port to the interface layer.
- 1 56. (Withdrawn) The heat exchanger according to claim 45 wherein the second layer further
2 comprises a plurality of fluid outlet grooves for channeling fluid from the interface layer
3 to at least one outlet port.
- 1 57. (Withdrawn) The heat exchanger according to claim 45 wherein the fluid is in single
2 phase flow conditions.
- 1 58. (Withdrawn) The heat exchanger according to claim 45 wherein at least a portion of the
2 fluid is in two phase flow conditions.
- 1 59. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer has a
2 thickness dimension within the range of and including 0.3 to 0.7 millimeters.
- 1 60. (Withdrawn) The heat exchanger according to claim 45 wherein an overhang dimension
2 is within the range of and including 0 to 15 millimeters.
- 1 61. (Withdrawn) The heat exchanger according to claim 45 wherein at least a portion of the
2 fluid undergoes a transition between single and two phase flow conditions in the heat
3 exchanger.
- 1 62. (Withdrawn) The heat exchanger according to claim 45 wherein the thermal conductivity
2 is at least 100 W/m-K.
- 1 63. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer further
2 comprises a plurality of pillars configured in a predetermined pattern along the first layer.
- 1 64. (Withdrawn) The heat exchanger according to claim 63 wherein at least one of the
2 plurality of pillars has an area dimension within the range of and including $(10 \text{ micron})^2$
3 and $(100 \text{ micron})^2$.

- 1 65. (Withdrawn) The heat exchanger according to claim 63 wherein at least one of the
2 plurality of pillars has a height dimension within the range of and including 50 microns
3 and 2 millimeters.
- 1 66. (Withdrawn) The heat exchanger according to claim 63 wherein at least two of the
2 plurality of pillars are separate from each other by a spacing dimension within the range
3 of and including 10 to 150 microns.
- 1 67. (Withdrawn) The heat exchanger according to claim 63 wherein at least one of the
2 plurality of pillars includes at least varying dimension along a predetermined direction.
- 1 68. (Withdrawn) The heat exchanger according to claim 63 wherein an appropriate number of
2 pillars are disposed in a predetermined area along the interface layer.
- 1 69. (Withdrawn) The heat exchanger according to claim 45 wherein at least a portion of the
2 first layer has a roughened surface.
- 1 70. (Withdrawn) The heat exchanger according to claim 63 wherein the plurality of pillars
2 include a coating thereupon, wherein the coating has an appropriate thermal conductivity
3 of at least 10 W/m-K.
- 1 71. (Withdrawn) The heat exchanger according to claim 45 wherein the interface layer is
2 made of a porous microstructure.
- 1 72. (Withdrawn) The heat exchanger according to claim 71 wherein the porous
2 microstructure has a porosity within the range of and including 50 to 80 percent.
- 1 73. (Withdrawn) The heat exchanger according to claim 71 wherein the porous
2 microstructure has an average pore size within the range of and including 10 to 200
3 microns.

- 1 74. (Withdrawn) The heat exchanger according to claim 71 wherein the porous
2 microstructure has a height dimension within the range of and including 0.25 to 2.00
3 millimeters.
- 1 75. (Withdrawn) The heat exchanger according to claim 71 wherein the porous
2 microstructure includes at least one pore having a varying dimension along a
3 predetermined direction.
- 1 76. (Withdrawn) The heat exchanger according to claim 45 further comprising a plurality of
2 microchannels disposed in a predetermined configuration along the first layer.
- 1 77. (Withdrawn) The heat exchanger according to claim 76 wherein at least one of the
2 plurality of microchannels has an area dimension within the range of and including (10
3 micron)² and (100 micron)².
- 1 78. (Withdrawn) The heat exchanger according to claim 76 wherein at least one of the
2 plurality of microchannels has a height dimension within the range of and including 50
3 microns and 2 millimeters.
- 1 79. (Withdrawn) The heat exchanger according to claim 76 wherein at least two of the
2 plurality of microchannels are separate from each other by a spacing dimension within the
3 range of and including 10 to 150 microns.
- 1 80. (Withdrawn) The heat exchanger according to claim 76 wherein at least one of the
2 plurality of microchannels has a width dimension within the range of and including 10 to
3 100 microns.
- 1 81. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer is coupled
2 to the heat source.
- 1 82. (Withdrawn) The heat exchanger according to claim 45 wherein the first layer is
2 integrally formed to the heat source.

- 1 83. (Withdrawn) The heat exchanger according to claim 45 wherein the heat source is an
2 integrated circuit.
- 1 84. (Withdrawn) The heat exchanger according to claim 45 further comprising a
2 thermoelectric device positioned between the first layer and the heat source, wherein the
3 thermoelectric device is electrically coupled to a power source.
- 1 85. (Withdrawn) The heat exchanger according to claim 84 wherein the thermoelectric device
2 is integrally formed within the heat exchanger.
- 1 86. (Withdrawn) The heat exchanger according to claim 84 wherein the thermoelectric device
2 is integrally formed within the heat source.
- 1 87. (Withdrawn) The heat exchanger according to claim 84 wherein the thermoelectric device
is coupled to the heat exchanger and the heat source.
- 1 88. (Withdrawn) A method of manufacturing a heat exchanger configured to cool a heat
2 source positioned along a plane, the method comprising the steps of:
3 a. providing a first layer configurable to be in contact with the heat source and to
4 pass fluid along a heat conducting surface, wherein the first layer has an
5 appropriate thermal conductivity to pass heat from the heat source to the fluid
6 passing along the heat conducting surface;
7 b. coupling a second layer having a thermal conductivity to the first layer, wherein a
8 first side of the second layer is in contact with the heat conducting surface to
9 receive heat therefrom and configured to pass fluid from the first layer
10 therethrough such that heat is passed from the second layer to the fluid; and
11 c. coupling a third layer to the first and second layers, wherein a second side of the
12 second layer is in contact with the third layer.
- 1 89. (Withdrawn) The method of manufacturing according to claim 88 wherein the first layer
2 further comprises a recess area having the heat conducting surface.

- 1 90. (Withdrawn) The method of manufacturing according to claim 88 wherein the heat
2 exchanger includes at least one inlet port for channeling fluid to the first side and at least
3 one outlet port for channeling fluid from the second side.
- 1 91. (Withdrawn) The method of manufacturing according to claim 90 wherein the first layer
2 includes the at least one inlet port.
- 1 92. (Withdrawn) The method of manufacturing according to claim 90 wherein the first layer
2 includes the at least one outlet port.
- 1 93. (Withdrawn) The method of manufacturing according to claim 90 wherein the third layer
2 includes the at least one inlet port.
- 1 94. (Withdrawn) The method of manufacturing according to claim 90 wherein the third layer
2 includes the at least one outlet port.
- 1 95. (Withdrawn) The method of manufacturing according to claim 90 wherein the at least one
2 inlet port is positioned substantially parallel with respect to the plane.
- 1 96. (Withdrawn) The method of manufacturing according to claim 90 wherein the at least one
2 inlet port is positioned substantially perpendicular with respect to the plane.
- 1 97. (Withdrawn) The method of manufacturing according to claim 90 wherein the at least one
2 outlet port is positioned substantially parallel with respect to the plane.
- 1 98. (Withdrawn) The method of manufacturing according to claim 90 wherein the at least one
2 outlet port is positioned substantially perpendicular with respect to the plane.
- 1 99. (Withdrawn) The method of manufacturing according to claim 89 wherein the recess area
2 includes a plurality of fluid inlet grooves along the heat conducting surface, the fluid inlet
3 grooves for channeling fluid from at least one inlet port to the second layer.

- 1 100. (Withdrawn) The method of manufacturing according to claim 88 wherein the fluid is in
2 single phase flow conditions.
- 1 101. (Withdrawn) The method of manufacturing according to claim 88 wherein at least a
2 portion of the fluid is in two phase flow conditions.
- 1 102. (Withdrawn) The method of manufacturing according to claim 88 wherein the first layer
2 has a thickness dimension within the range of and including 0.3 to 0.7 millimeters.
- 1 103. (Withdrawn) The method of manufacturing according to claim 88 wherein an overhang
2 dimension is within the range of and including 0 to 15 millimeters.
- 1 104. (Withdrawn) The method of manufacturing according to claim 88 wherein at least a
2 portion of the fluid undergoes a transition between single and two phase flow conditions
3 in the heat exchanger.
- 1 105. (Withdrawn) The method of manufacturing according to claim 88 wherein the first layer
2 is made of a material having a thermal conductivity of at least 100 W/m-K.
- 1 106. (Withdrawn) The method of manufacturing according to claim 88 further comprising
2 forming a plurality of pillars in a predetermined pattern along the first layer.
- 1 107. (Withdrawn) The method of manufacturing according to claim 106 wherein at least one
2 of the plurality of pillars has an area dimension within the range of and including (10
3 micron)² and (100 micron)².
- 1 108. (Withdrawn) The method of manufacturing according to claim 106 wherein at least one
2 of the plurality of pillars has a height dimension within the range of and including 50
3 microns and 2 millimeters.
- 1 109. (Withdrawn) The method of manufacturing according to claim 106 wherein at least two
2 of the plurality of pillars are separate from each other by a spacing dimension within the
3 range of and including 10 to 150 microns.

- 1 110. (Withdrawn) The method of manufacturing according to claim 106 wherein at least one
2 of the plurality of pillars includes at least varying dimension along a predetermined
3 direction.
- 1 111. (Withdrawn) The method of manufacturing according to claim 88 further comprising
2 configuring at least a portion of the first layer to have a roughened surface.
- 1 112. (Withdrawn) The method of manufacturing according to claim 88 wherein the second
2 layer is made of a micro-porous structure.
- 1 113. (Withdrawn) The method of manufacturing according to claim 112 wherein the porous
2 microstructure has a porosity within the range of and including 50 to 80 percent.
- 1 114. (Withdrawn) The method of manufacturing according to claim 112 wherein the porous
2 microstructure has an average pore size within the range of and including 10 to 200
3 microns.
- 1 115. (Withdrawn) The method of manufacturing according to claim 112 wherein the porous
2 microstructure has a height dimension within the range of and including 0.25 to 2.00
millimeters.
- 1 116. (Withdrawn) The method of manufacturing according to claim 88 further comprising
2 forming a plurality of microchannels onto the first layer.
- 1 117. (Withdrawn) The method of manufacturing according to claim 116 wherein at least one
2 of the plurality of microchannels has an area dimension within the range of and including
3 $(10 \text{ micron})^2$ and $(100 \text{ micron})^2$.
- 1 118. (Withdrawn) The method of manufacturing according to claim 116 wherein at least one
2 of the plurality of microchannels has a height dimension within the range of and
3 including 50 microns and 2 millimeters.

- 1 119. (Withdrawn) The method of manufacturing according to claim 116 wherein at least two
2 of the plurality of microchannels are separate from each other by a spacing dimension
3 within the range of and including 10 to 150 microns.
- 1 120. (Withdrawn) The method of manufacturing according to claim 116 wherein at least one
2 of the plurality of microchannels has a width dimension within the range of and including
3 10 to 100 microns.
- 1 121. (Withdrawn) The method of manufacturing according to claim 88 wherein the first layer
2 is coupled to the heat source.
- 1 122. (Withdrawn) The method of manufacturing according to claim 88 wherein the first layer
2 is integrally formed to the heat source.
- 1 123. (Withdrawn) The method of manufacturing according to claim 88 wherein the heat source
2 is an integrated circuit.
- 1 124. (Withdrawn) The method of manufacturing according to claim 88 further comprising
2 configuring a thermoelectric device between the first layer and the heat source, wherein
3 the thermoelectric device is electrically coupled to a power source.
- 1 125. (Withdrawn) The method of manufacturing according to claim 124 wherein the
2 thermoelectric device is integrally formed within the heat exchanger.
- 1 126. (Withdrawn) The method of manufacturing according to claim 124 wherein the
2 thermoelectric device is integrally formed within the heat source.
- 1 127. (Withdrawn) The method of manufacturing according to claim 124 wherein the
2 thermoelectric device is coupled to the heat exchanger and the heat source.
- 1 128. (New) The heat exchanger according to claim 1 further comprising a heat source
2 including at least one interface hot spot region, wherein the fluid is distributed to
3 selectively cool the at least one interface hot spot region.